U.S. Department of Transportation
**Federal Aviation Administration**

# Advisory Circular

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| **Subject:** TAXI, TAKEOFF **AND** LANDING ROLL DESIGN LOADS | **Date:** 10/30/00 **Initiated By:** ANM-110 | **AC No:** 25.491-1 **Change:** |

1. PURPOSE. This advisory circular (AC) sets forth acceptable methods of compliance with the provisions of part 25 of the Federal Aviation Regulations (FAR) dealing with the certification requirements for taxi, takeoff and landing roll design loads. Guidance information is provided for showing compliance with § 25.491 of the FAR, relating to structural design for airplane operation on paved runways and taxiways normally used in commercial operations, Other methods of compliance with the requirements may be acceptable.

2. RELATED FAR SECTIONS. The contents of this AC are considered by the Federal Aviation Administration (FAA) in determining compliance with § 25.491 of the FAR. Related sections are §§ 25.305(c) and 25.235.

3. BACKGROUND.

a. All paved runways and taxiways have an inherent degree of surface unevenness, or roughness. This is the result of the normal tolerances of engineering standards required for construction, as well as the result of events such as uneven settlement and frost heave. In addition, repair of surfaces on an active runway or taxiway can result in temporary ramped surfaces. Many countries have developed criteria for runway surface roughness. The International Civil Aviation Organization (ICAO) standards are published in ICAO Annex 14.

b. In the late 1940's, as airplanes became larger, more flexible, and operated at higher ground speeds, consideration of dynamic loads during taxi, landing rollout, and takeoff became important in airplane design. The Civil Aeronautics Administration, in Civil Air Regulations 4b (CAR 4b), § 4b. 172, required the effects of landing gear deflection during taxiing over the roughest ground expected in service to be considered relative to its effect on damage to structural components. The CAR 4b, § 4b.235, also required the airplane be designed, in part, to withstand loads calculated under § 4b. 172. Those regulations were carried over to part 25 of the

FAR as § 25.235 and § 25.491 respectively. Substantiation of the effect of ground loads on flexible structure is required by § 25.305(c).

c. Several approaches had been taken by different manufacturers in complying with the noted regulations. If dynamic effects due to rigid body modes or airframe flexibility during taxi were not considered critical, some manufacturers used a simplified static analysis where a static inertia force was applied to the airplane using a load factor of 2.0 for single axle gears or 1.7 for multiple axle gears. The lower 1.7 factor was justified based on an assumption that there was a load alleviating effect resulting from rotation of the beam, on which the forward and aft axles are attached, about the central pivot point on the strut. The static load factor approach was believed to encompass any dynamic effects and it had the benefit of a relatively simple analysis.

d. As computers became more powerful and dynamic analysis methods became more sophisticated, it was found that dynamic effects sometimes resulted in loads greater than those which were predicted by the static criterion. Some manufacturers performed calculations using a series of harmonic bumps to represent a runway surface, tuning the bumps to excite various portions of the structure at a given speed. U.S. Military Standard 8862 defines amplitude and wavelengths of l-cosine bumps intended to excite low speed plunge, pitch and wing first bending modes.

e. Some manufacturers used actual runway profile data to calculate loads. The runway profiles of the San Francisco Runway 28R or Anchorage Runway 24, which were known to cause high loads on airplanes and were the subject of pilot complaints until resurfaced, have been used in a series of bi-directional constant speed analytical runs to determine loads. In some cases, accelerated runs have been used, starting from several points along the runway. The profiles of those runways are described in NASA Reports CR-l 19 and TN D-5703. Such deterministic dynamic analyses have in general proved to be satisfactory.

f. Some manufacturers have used a statistical power spectral density (PSD) approach, especially to calculate fatigue loads. Extensive PSD runway roughness data exist for numerous world runways. The PSD approach is not considered practical for calculation of limit loads.

g. Because the various methods described above produce different results, the guidance information given in paragraphs 4, 5, and 6 of this AC should be used when demonstrating compliance with § 25.491.

## 4. RUNWAY PROFILE CONDITION.

a. Consideration of airframe flexibility and landing gear dynamic characteristics is necessary in most cases. A deterministic dynamic analysis, based on the San Francisco Runway 28R (before it was resurfaced), described in Table 1 of this AC, is an acceptable method for compliance. As an alternative means of compliance, the San Francisco Runway 28R (before it was resurfaced) may be used with the severe bump from 1530 to 1538 feet modified per Table 2. The modifications to the bump reflect the maximum slope change permitted in ICAO Annex 14 for temporary ramps used to

transition asphalt overlays to existing pavement. The points affected by this modification are outlined in Table 1.

b. Airplane design loads should be developed for the mostcritical conditions arising from taxi, takeoff, and landing run. The airplane analysis model should include significant airplane rigid body and flexible modes, and the appropriate landing gear and tire characteristics. Unless the airplane has design features that would result in significant asymmetric loads, only the symmetric cases need be investigated.

c. Airplane steady aerodynamic effects should normally be included. However, they may be ignored if their deletion is shown to produce conservative loads. Unsteady aerodynamic effects on dynamic response may be neglected.

d. Conditions should be run at the maximum takeoff weight and the maximum landing weight with critical combinations of wing fuel, payload, and extremes of center of gravity (c.g.) range. For airplanes with trimable stabilizers, the stabilizer should be at the appropriate setting for takeoff cases and at the recommended final approach setting for landing cases. The elevator should be assumed faired relative to the stabilizer throughout the takeoff or landing nm, unless other normal procedures are specified in the flight manual.

e. A series of constant speed runs should be made in both directions from 20 knots up to the maximum ground speeds expected in normal operation ($V_R$ defined at maximum altitude and temperature for takeoff conditions, 1.25 $V_{L2}$ for landing conditions). Sufficiently small speed increments should be evaluated to assure that maximum loads are achieved. Constant speed runs should be made because using accelerated runs may not define the speed/roughness points which could produce peak dynamic loads. For maximum take-off weight cases, the analysis should account for normal takeoff flap and control settings and consider both zero and maximum thrust. For maximum landing weight cases, the analysis should account for normal flap and spoiler positions following landing, and steady pitching moments equivalent to those produced by braking with a coefficient of friction of 0.3 with and without reverse thrust. The effects of automatic braking systems that reduce braking in the presence of reverse thrust may be taken into account.

5. DISCRETE LOAD CONDITION. One of the following discrete limit load conditions should be evaluated:

a. With all landing gears in contact with the ground, the condition of a vertical load equal to 1.7 times the static ground reaction should be investigated under the most adverse airplane loading distribution at maximum takeoff weight, with and without thrust from the engines;

b. As an alternative to paragraph 5(a) above, it would be acceptable to undertake dynamic analyses under the same conditions considered in paragraph 4 of this AC considering the aircraft response to each of the following pairs of identical and contiguous l-cosine upwards bumps on an otherwise smooth runway:

(i) Bump wavelengths equal to the mean longitudinal distance between nose and main landing gears, or between the main and tail landing gears, as appropriate; and separately.

(ii) Bump wavelengths equal to twice this distance.

The bump height in each case should be defined as:

$$H = 1.2 + 0.023 \sqrt{L}$$

Where--

H = the bump height (inches)

L = the bump wavelength (inches)

6. COMBINED LOAD CONDITION. A condition of combined vertical, side and drag loads should be investigated for the main landing gear. In the absence of a more rational analysis a vertical load equal to 90% of the ground reaction from paragraph 5 above should be combined with a drag load of 20% of the vertical load and a side load of 20% of the vertical load. Side loads acting either direction should be considered.

7. TIRE CONDITIONS. The calculation of maximum gear loads in accordance with paragraphs 4, 5, and 6, may be performed using fully inflated tires. For multiple wheel units, the maximum gear loads should be distributed between the wheels in accordance with the criteria of § 25.5 11.

**TABLE 1**

**SAN FRANCISCO RUNWAY 28R**

ONE TRACK
LENGTH: 3880 FEET
NUMBER OF POINTS: 194 1
POINT SPACING: 2 FEET
ELEVATIONS: FEET
REFERENCE SOURCE: REPORT TO NASA (EFFECTS OF RUNWAY ' UNEVENNESS ON THE DYNAMIC RESPONSE OF SUPERSONIC TRANSPORTS), JULY 1964 ·, U. OF CALIF. BERKLEY.
**RUNWAY ELEVATION POINTS IN FEET:**

| Dist. | Elev. | Dist. | Elev. | Dist. | Elev. | Dist. | Elev. | Dist. | Elev. |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 10.3 | 776 | 10.99 | 1552 | 10.92 | 2328 | 11.16 | 3104 | 11.93 |
| 2 | 10.31 | 778 | 10.98 | 1554 | 10.92 | 2330 | 11.15 | 3106 | 11.92 |
| 4 | 10.3 | 780 | 10.99 | 1556 | 10.91 | 2332 | 11.14 | 3108 | 11.92 |
| 6 | 10.3 | 782 | 10.99 | 1558 | 10.93 | 2334 | 11.14 | 3110 | 11.92 |
| 8 | 10.31 | 784 | 11 | 1560 | 10.93 | 2336 | 11.14 | 3112 | 11.92 |
| 10 | 10.32 | 786 | 11.01 | 1562 | 10.93 | 2338 | 11.14 | 3114 | 11.92 |
| 12 | 10.33 | 788 | 11.01 | 1564 | 10.93 | 2340 | 11.14 | 3116 | 11.92 |
| 14 | 10.34 | 790 | 11.01 | 1566 | 10.93 | 2342 | 11.14 | 3118 | 11.92 |
| 16 | 10.35 | 792 | 11.03 | 1568 | 10.93 | 2344 | 11.15 | 3120 | 11.92 |
| 18 | 10.36 | 794 | 11.04 | 1570 | 10.93 | 2346 | 11.15 | 3122 | 11.92 |
| 20 | 10.36 | 796 | 11.03 | 1572 | 10.93 | 2348 | 11.15 | 3124 | 11.92 |
| 22 | 10.37 | 798 | 11.05 | 1574 | 10.93 | 2350 | 11.15 | 3126 | 11.92 |
| 24 | 10.37 | 800 | 11.06 | 1576 | 10.93 | 2352 | 11.15 | 3128 | 11.91 |
| 26 | 10.37 | 802 | 11.07 | 1578 | 10.93 | 2354 | 11.15 | 3130 | 11.9 |
| 28 | 10.38 | 804 | 11.06 | 1580 | 10.94 | 2356 | 11.16 | 3132 | 11.9 |
| 30 | 10.39 | 806 | 11.07 | 1582 | 10.94 | 2358 | 11.16 | 3134 | 11.9 |
| 32 | 10.4 | 808 | 11.08 | 1584 | 10.94 | 2360 | 11.15 | 3136 | 11.9 |
| 34 | 10.4 | 810 | 11.08 | 1586 | 10.94 | 2362 | 11.15 | 3138 | 11.9 |
| 36 | 10.41 | 812 | 11.08 | 1588 | 10.95 | 2364 | 11.16 | 3140 | 11.9 |
| 38 | 10.41 | 814 | 11.09 | 1590 | 10.94 | 2366 | 11.16 | 3142 | 11.9 |
| 40 | 10.42 | 816 | 11.09 | 1592 | 10.93 | 2368 | 11.16 | 3144 | 11.9 |
| 42 | 10.43 | 818 | 11.08 | 1594 | 10.94 | 2370 | 11.16 | 3146 | 11.9 |
| 44 | 10.43 | 820 | 11.08 | 1596 | 10.94 | 2372 | 11.16 | 3148 | 11.9 |
| 46 | 10.44 | 822 | 11.08 | 1598 | 10.93 | 2374 | 11.16 | 3150 | 11.9 |
| 48 | 10.44 | 824 | 11.08 | 1600 | 10.92 | 2376 | 11.16 | 3152 | 11.9 |
| 50 | 10.44 | 826 | 11.08 | 1602 | 10.92 | 2378 | 11.16 | 3154 | 11.9 |
| 52 | 10.44 | 828 | 11.08 | 1604 | 10.92 | 2380 | 11.17 | 3156 | 11.9 |
| 54 | 10.44 | 830 | 11.07 | 1606 | 10.91 | 2382 | 11.17 | 3158 | 11.9 |
| 56 | 10.45 | 832 | 11.08 | 1608 | 10.91 | 2384 | 11.17 | 3160 | 11.9 |
| 58 | 10.46 | 834 | 11.08 | 1610 | 10.91 | 2386 | 11.17 | 3162 | 11.89 |
| 60 | 10.47 | 836 | 11.08 | 1612 | 10.91 | 2388 | 11.17 | 3164 | 11.88 |
| 62 | 10.47 | 838 | 11.08 | 1614 | 10.9 | 2390 | 11.17 | 3166 | 11.88 |
| 64 | 10.48 | 840 | 11.09 | 1616 | 10.89 | 2392 | 11.17 | 3168 | 11.87 |
| 66 | 10.49 | 842 | 11.08 | 1618 | 10.88 | 2394 | 11.16 | 3170 | 11.87 |
| 68 | 10.49 | 844 | 11.08 | 1620 | 10.87 | 2396 | 11.15 | 3172 | 11.86 |
| 70 | 10.5 | 846 | 11.07 | 1622 | 10.89 | 2398 | 11.15 | 3174 | 11.86 |
| 72 | 10.5 | 848 | 11.07 | 1624 | 10.88 | 2400 | 11.14 | 3176 | 11.85 |
| 74 | 10.5 | 850 | 11.06 | | 10.88 | 2402 | 11.14 | 3178 | 11.85 |

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|---|---|---|---|---|---|---|---|---|---|
| 76 | 10.5 | 852 | 11.05 | 1628 | 10.88 | 2404 | 11.14 | 3180 | 11.84 |
| 78 | 10.5 | 854 | 11.05 | 1630 | 10.87 | 2406 | 11.13 | 3182 | 11.84 |
| 80 | 10.5 | 856 | 11.04 | 1632 | 10.86 | 2408 | 11.12 | 3184 | 11.84 |
| 82 | 10.49 | 858 | 11.05 | 1634 | 10.85 | 2410 | 11.12 | 3186 | 11.84 |
| 84 | 10.49 | 860 | 11.04 | 1636 | 10.86 | 2412 | 11.12 | 3188 | 11.84 |
| 86 | 10.49 | 862 | 11.04 | 1638 | 10.86 | 2414 | 11.12 | 3190 | 11.85 |
| 88 | 10.49 | 864 | 11.04 | 1640 | 10.85 | 2416 | 11.12 | 3192 | 11.87 |
| 90 | 10.5 | 866 | 11.04 | 1642 | 10.85 | 2418 | 11.12 | 3194 | 11.89 |
| 92 | 10.5 | 868 | 11.04 | 1644 | 10.85 | 2420 | 11.13 | 3196 | 11.89 |
| 94 | 10.51 | 870 | 11.04 | 1646 | 10.84 | 2422 | 11.13 | 3198 | 11.9 |
| 96 | 10.51 | 872 | 11.04 | 1648 | 10.84 | 2424 | 11.14 | 3200 | 11.89 |
| 98 | 10.52 | 874 | 11.03 | 1650 | 10.84 | 2426 | 11.15 | 3202 | 11.92 |
| 100 | 10.52 | 876 | 11.03 | 1652 | 10.83 | 2428 | 11.16 | 3204 | 11.95 |
| 102 | 10.52 | 878 | 11.03 | 1654 | 10.83 | 2430 | 11.17 | 3206 | 11.95 |
| 104 | 10.53 | 880 | 11.03 | 1656 | 10.82 | 2432 | 11.18 | 3208 | 11.95 |
| 106 | 10.53 | 882 | 11.02 | 1658 | 10.82 | 2434 | 11.19 | 3210 | 11.94 |
| 108 | 10.54 | 884 | 11.02 | 1660 | 10.81 | 2436 | 11.2 | 3212 | 11.94 |
| 110 | 10.54 | 886 | 11.02 | 1662 | 10.81 | 2438 | 11.2 | 3214 | 11.93 |
| 112 | 10.55 | 888 | 11.02 | 1664 | 10.8 | 2440 | 11.22 | 3216 | 11.92 |
| 114 | 10.55 | 890 | 11.02 | 1666 | 10.79 | 2442 | 11.23 | 3218 | 11.92 |
| 116 | 10.55 | 892 | 11.02 | 1668 | 10.79 | 2444 | 11.24 | 3220 | 11.91 |
| 118 | 10.55 | 894 | 11.03 | 1670 | 10.79 | 2446 | 11.24 | 3222 | 11.9 |
| 120 | 10.54 | 896 | 11.03 | 1672 | 10.79 | 2448 | 11.25 | 3224 | 11.9 |
| 122 | 10.55 | 898 | 11.04 | 1674 | 10.79 | 2450 | 11.26 | 3226 | 11.89 |
| 124 | 10.55 | 900 | 11.05 | 1676 | 10.79 | 2452 | 11.27 | 3228 | 11.88 |
| 126 | 10.56 | 902 | 11.05 | 1678 | 10.8 | 2454 | 11.28 | 3230 | 11.87 |
| 128 | 10.57 | 904 | 11.06 | 1680 | 10.8 | 2456 | 11.28 | 3232 | 11.86 |
| 130 | 10.57 | 906 | 11.06 | 1682 | 10.81 | 2458 | 11.29 | 3234 | 11.85 |
| 132 | 10.57 | 908 | 11.06 | 1684 | 10.82 | 2460 | 11.3 | 3236 | 11.84 |
| 134 | 10.57 | 910 | 11.07 | 1686 | 10.82 | 2462 | 11.3 | 3238 | 11.84 |
| 136 | 10.57 | 912 | 11.07 | 1688 | 10.83 | 2464 | 11.3 | 3240 | 11.84 |
| 138 | 10.58 | 914 | 11.07 | 1690 | 10.84 | 2466 | 11.31 | 3242 | 11.83 |
| 140 | 10.57 | 916 | 11.07 | 1692 | 10.85 | 2468 | 11.3 | 3244 | 11.82 |
| 142 | 10.57 | 918 | 11.07 | 1694 | 10.85 | 2470 | 11.31 | 3246 | 11.82 |
| 144 | 10.58 | 920 | 11.08 | 1696 | 10.85 | 2472 | 11.31 | 3248 | 11.81 |
| 146 | 10.57 | 922 | 11.08 | 1698 | 10.87 | 2474 | 11.31 | 3250 | 11.83 |
| 148 | 10.56 | 924 | 11.07 | 1700 | 10.87 | 2476 | 11.31 | 3252 | 11.83 |
| 150 | 10.56 | 926 | 11.07 | 1702 | 10.88 | 2478 | 11.3 | 3254 | 11.83 |
| 152 | 10.56 | 928 | 11.07 | 1704 | 10.87 | 2480 | 11.3 | 3256 | 11.84 |
| 154 | 10.56 | 930 | 11.06 | 1706 | 10.88 | 2482 | 11.3 | 3258 | 11.84 |
| 156 | 10.56 | 932 | 11.06 | 1708 | 10.87 | 2484 | 11.29 | 3260 | 11.84 |
| 158 | 10.56 | 934 | 11.06 | 1710 | 10.87 | 2486 | 11.29 | 3262 | 11.84 |
| 160 | 10.56 | 936 | 11.06 | 1712 | 10.87 | 2488 | 11.29 | 3264 | 11.82 |
| 162 | 10.56 | 938 | 11.06 | 1714 | 10.87 | 2490 | 11.29 | 3266 | 11.83 |
| 164 | 10.55 | 940 | 11.07 | 1716 | 10.86 | 2492 | 11.29 | 3268 | 11.82 |
| 166 | 10.55 | 942 | 11.07 | 1718 | 10.85 | 2494 | 11.29 | 3270 | 11.83 |
| 168 | 10.55 | 944 | 11.08 | 1720 | 10.84 | 2496 | 11.29 | 3272 | 11.83 |
| 170 | 10.56 | 946 | 11.08 | 1722 | 10.84 | 2498 | 11.29 | 3274 | 11.84 |
| 172 | 10.57 | 948 | 11.09 | 1724 | 10.84 | 2500 | 11.29 | 3276 | 11.84 |
| 174 | 10.57 | 950 | 11.09 | 1726 | 10.84 | 2502 | 11.3 | 3278 | 11.84 |
| 176 | 10.57 | 952 | 11.09 | 1728 | 10.84 | 2504 | 11.3 | 3280 | 11.85 |
| 178 | 10.57 | 954 | 11.09 | 1730 | 10.83 | 2506 | 11.31 | 3282 | 11.84 |

| Dist. | Elev. | Dist. | Elev. | Dist. | Elev. | Dist. | Elev. | Dist. | Elev. |
|---|---|---|---|---|---|---|---|---|---|
| 180 | 10.56 | 956 | 11.1 | 1732 | 10.82 | 2508 | 11.31 | 3284 | 11.84 |
| 182 | 10.55 | 958 | 11.09 | 1734 | 10.82 | 2510 | 11.32 | 3286 | 11.84 |
| 184 | 10.55 | 960 | 11.09 | 1736 | 10.82 | 2512 | 11.32 | 3288 | 11.85 |
| 186 | 10.55 | 962 | 11.09 | 1738 | 10.82 | 2514 | 11.33 | 3290 | 11.85 |
| 188 | 10.55 | 964 | 11.09 | 1740 | 10.82 | 2516 | 11.33 | 3292 | 11.85 |
| 190 | 10.55 | 966 | 11.08 | 1742 | 10.82 | 2518 | 11.34 | 3294 | 11.86 |
| 192 | 10.56 | 968 | 11.08 | 1744 | 10.83 | 2520 | 11.35 | 3296 | 11.86 |
| 194 | 10.56 | 970 | 11.07 | 1746 | 10.82 | 2522 | 11.35 | 3298 | 11.84 |
| 196 | 10.56 | 972 | 11.07 | 1748 | 10.83 | 2524 | 11.35 | 3300 | 11.84 |
| 198 | 10.56 | 974 | 11.06 | 1750 | 10.82 | 2526 | 11.35 | 3302 | 11.84 |
| 200 | 10.55 | 976 | 11.07 | 1752 | 10.82 | 2528 | 11.35 | 3304 | 11.84 |
| 202 | 10.54 | 978 | 11.09 | 1754 | 10.82 | 2530 | 11.35 | 3306 | 11.84 |
| 204 | 10.53 | 980 | 11.1 | 1756 | 10.82 | 2532 | 11.36 | 3308 | 11.84 |
| 206 | 10.52 | 982 | 11.1 | 1758 | 10.81 | 2534 | 11.36 | 3310 | 11.84 |
| 208 | 10.52 | 984 | 11.11 | 1760 | 10.81 | 2536 | 11.35 | 3312 | 11.84 |
| 210 | 10.52 | 986 | 11.11 | 1762 | 10.81 | 2538 | 11.35 | 3314 | 11.84 |
| 212 | 10.52 | 988 | 11.12 | 1764 | 10.81 | 2540 | 11.35 | 3316 | 11.84 |
| 214 | 10.52 | 990 | 11.12 | 1766 | 10.82 | 2542 | 11.35 | 3318 | 11.84 |
| 216 | 10.52 | 992 | 11.12 | 1768 | 10.82 | 2544 | 11.35 | 3320 | 11.84 |
| 218 | 10.53 | 994 | 11.11 | 1770 | 10.82 | 2546 | 11.35 | 3322 | 11.83 |
| 220 | 10.52 | 996 | 11.11 | 1772 | 10.83 | 2548 | 11.34 | 3324 | 11.83 |
| 222 | 10.52 | 998 | 11.11 | 1774 | 10.83 | 2550 | 11.34 | 3326 | 11.83 |
| 224 | 10.51 | 1000 | 11.11 | 1776 | 10.83 | 2552 | 11.34 | 3328 | 11.82 |
| 226 | 10.52 | 1002 | 11.11 | 1778 | 10.84 | 2554 | 11.34 | 3330 | 11.83 |
| 228 | 10.52 | 1004 | 11.1 | 1780 | 10.84 | 2556 | 11.35 | 3332 | 11.83 |
| 230 | 10.51 | 1006 | 11.11 | 1782 | 10.85 | 2558 | 11.35 | 3334 | 11.83 |
| 232 | 10.52 | 1008 | 11.11 | 1784 | 10.86 | 2560 | 11.35 | 3336 | 11.82 |
| 234 | 10.52 | 1010 | 11.12 | 1786 | 10.86 | 2562 | 11.34 | 3338 | 11.82 |
| 236 | 10.53 | 1012 | 11.12 | 1788 | 10.86 | 2564 | 11.33 | 3340 | 11.83 |
| 238 | 10.53 | 1014 | 11.12 | 1790 | 10.88 | 2566 | 11.33 | 3342 | 11.82 |
| 240 | 10.53 | 1016 | 11.11 | 1792 | 10.87 | 2568 | 11.33 | 3344 | 11.83 |
| 242 | 10.53 | 1018 | 11.11 | 1794 | 10.86 | 2570 | 11.33 | 3346 | 11.83 |
| 244 | 10.53 | 1020 | 11.12 | 1796 | 10.86 | 2572 | 11.33 | 3348 | 11.84 |
| 246 | 10.53 | 1022 | 11.11 | 1798 | 10.86 | 2574 | 11.33 | 3350 | 11.84 |
| 248 | 10.53 | 1024 | 11.11 | 1800 | 10.87 | 2576 | 11.33 | 3352 | 11.83 |
| 250 | 10.53 | 1026 | 11.11 | 1802 | 10.87 | 2578 | 11.32 | 3354 | 11.83 |
| 252 | 10.53 | 1028 | 11.1 | 1804 | 10.86 | 2580 | 11.33 | 3356 | 11.83 |
| 254 | 10.52 | 1030 | 11.1 | 1806 | 10.85 | 2582 | 11.33 | 3358 | 11.83 |
| 256 | 10.53 | 1032 | 11.12 | 1808 | 10.85 | 2584 | 11.33 | 3360 | 11.83 |
| 258 | 10.54 | 1034 | 11.13 | 1810 | 10.89 | 2586 | 11.33 | 3362 | 11.84 |
| 260 | 10.54 | 1036 | 11.15 | 1812 | 10.91 | 2588 | 11.33 | 3364 | 11.84 |
| 262 | 10.54 | 1038 | 11.16 | 1814 | 10.91 | 2590 | 11.34 | 3366 | 11.84 |
| 264 | 10.54 | 1040 | 11.17 | 1816 | 10.92 | 2592 | 11.34 | 3368 | 11.85 |
| 266 | 10.54 | 1042 | 11.18 | 1818 | 10.92 | 2594 | 11.34 | 3370 | 11.85 |
| 268 | 10.54 | 1044 | 11.18 | 1820 | 10.93 | 2596 | 11.35 | 3372 | 11.85 |
| 270 | 10.55 | 1046 | 11.19 | 1822 | 10.93 | 2598 | 11.35 | 3374 | 11.85 |
| 272 | 10.55 | 1048 | 11.19 | 1824 | 10.93 | 2600 | 11.35 | 3376 | 11.84 |
| 274 | 10.54 | 1050 | 11.2 | 1826 | 10.94 | 2602 | 11.35 | 3378 | 11.84 |
| 276 | 10.55 | 1052 | 11.22 | 1828 | 10.94 | 2604 | 11.35 | 3380 | 11.85 |
| 278 | 10.55 | 1054 | 11.22 | 1830 | 10.95 | 2606 | 11.35 | 3382 | 11.85 |
| 280 | 10.56 | 1056 | 11.23 | 1832 | 10.94 | 2608 | 11.35 | 3384 | 11.86 |

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|---|---|---|---|---|---|---|---|---|---|
| 282 | 10.57 | 1058 | 11.23 | 1834 | 10.93 | 2610 | 11.35 | 3386 | 11.86 |
| 284 | 10.58 | 1060 | 11.23 | 1836 | 10.93 | 2612 | 11.36 | 3388 | 11.87 |
| 286 | 10.59 | 1062 | 11.24 | 1838 | 10.92 | 2614 | 11.36 | 3390 | 11.87 |
| 288 | 10.6 | 1064 | 11.25 | 1840 | 10.93 | 2616 | 11.36 | 3392 | 11.87 |
| 290 | 10.61 | 1066 | 11.25 | 1842 | 10.91 | 2618 | 11.35 | 3394 | 11.87 |
| 292 | 10.62 | 1068 | 11.26 | 1844 | 10.91 | 2620 | 11.35 | 3396 | 11.87 |
| 294 | 10.63 | 1070 | 11.24 | 1846 | 10.9 | 2622 | 11.35 | 3398 | 11.86 |
| 296 | 10.65 | 1072 | 11.27 | 1848 | 10.9 | 2624 | 11.35 | 3400 | 11.87 |
| 298 | 10.66 | 1074 | 11.28 | 1850 | 10.9 | 2626 | 11.35 | 3402 | 11.87 |
| 300 | 10.66 | 1076 | 11.28 | 1852 | 10.91 | 2628 | 11.35 | 3404 | 11.88 |
| 302 | 10.67 | 1078 | 11.3 | 1854 | 10.91 | 2630 | 11.36 | 3406 | 11.89 |
| 304 | 10.66 | 1080 | 11.31 | 1856 | 10.89 | 2632 | 11.36 | 3408 | 11.89 |
| 306 | 10.67 | 1082 | 11.32 | 1858 | 10.9 | 2634 | 11.36 | 3410 | 11.89 |
| 308 | 10.67 | 1084 | 11.33 | 1860 | 10.91 | 2636 | 11.36 | 3412 | 11.91 |
| 310 | 10.67 | 1086 | 11.34 | 1862 | 10.91 | 2638 | 11.36 | 3414 | 11.91 |
| 312 | 10.67 | 1088 | 11.34 | 1864 | 10.91 | 2640 | 11.37 | 3416 | 11.92 |
| 314 | 10.67 | 1090 | 11.34 | 1866 | 10.92 | 2642 | 11.38 | 3418 | 11.93 |
| 316 | 10.66 | 1092 | 11.34 | 1868 | 10.93 | 2644 | 11.38 | 3420 | 11.95 |
| 318 | 10.66 | 1094 | 11.33 | 1870 | 10.94 | 2646 | 11.39 | 3422 | 11.95 |
| 320 | 10.65 | 1096 | 11.32 | 1872 | 10.94 | 2648 | 11.39 | 3424 | 11.96 |
| 322 | 10.65 | 1098 | 11.32 | 1874 | 10.94 | 2650 | 11.4 | 3426 | 11.96 |
| 324 | 10.65 | 1100 | 11.31 | 1876 | 10.94 | 2652 | 11.41 | 3428 | 11.96 |
| 326 | 10.65 | 1102 | 11.32 | 1878 | 10.94 | 2654 | 11.42 | 3430 | 11.96 |
| 328 | 10.66 | 1104 | 11.32 | 1880 | 10.95 | 2656 | 11.42 | 3432 | 11.95 |
| 330 | 10.67 | 1106 | 11.31 | 1882 | 10.93 | 2658 | 11.43 | 3434 | 11.96 |
| 332 | 10.67 | 1108 | 11.31 | 1884 | 10.93 | 2660 | 11.43 | 3436 | 11.96 |
| 334 | 10.67 | 1110 | 11.31 | 1886 | 10.93 | 2662 | 11.42 | 3438 | 11.96 |
| 336 | 10.68 | 1112 | 11.32 | 1888 | 10.93 | 2664 | 11.42 | 3440 | 11.96 |
| 338 | 10.68 | 1114 | 11.31 | 1890 | 10.92 | 2666 | 11.43 | 3442 | 11.95 |
| 340 | 10.68 | 1116 | 11.32 | 1892 | 10.93 | 2668 | 11.43 | 3444 | 11.95 |
| 342 | 10.69 | 1118 | 11.33 | 1894 | 10.93 | 2670 | 11.43 | 3446 | 11.94 |
| 344 | 10.69 | 1120 | 11.34 | 1896 | 10.93 | 2672 | 11.43 | 3448 | 11.96 |
| 346 | 10.69 | 1122 | 11.35 | 1898 | 10.93 | 2674 | 11.43 | 3450 | 11.98 |
| 348 | 10.7 | 1124 | 11.35 | 1900 | 10.91 | 2676 | 11.43 | 3452 | 11.99 |
| 350 | 10.71 | 1126 | 11.36 | 1902 | 10.9 | 2678 | 11.44 | 3454 | 12.01 |
| 352 | 10.71 | 1128 | 11.36 | 1904 | 10.91 | 2680 | 11.44 | 3456 | 12.03 |
| 354 | 10.72 | 1130 | 11.36 | 1906 | 10.91 | 2682 | 11.45 | 3458 | 12.04 |
| 356 | 10.72 | 1132 | 11.37 | 1908 | 10.91 | 2684 | 11.46 | 3460 | 12.05 |
| 358 | 10.71 | 1134 | 11.37 | 1910 | 10.91 | 2686 | 11.46 | 3462 | 12.05 |
| 360 | 10.72 | 1136 | 11.37 | 1912 | 10.91 | 2688 | 11.47 | 3464 | 12.05 |
| 362 | 10.72 | 1138 | 11.37 | 1914 | 10.91 | 2690 | 11.48 | 3466 | 12.05 |
| 364 | 10.72 | 1140 | 11.38 | 1916 | 10.91 | 2692 | 11.48 | 3468 | 12.05 |
| 366 | 10.71 | 1142 | 11.38 | 1918 | 10.9 | 2694 | 11.49 | 3470 | 12.05 |
| 368 | 10.72 | 1144 | 11.38 | 1920 | 10.9 | 2696 | 11.49 | 3472 | 12.04 |
| 370 | 10.72 | 1146 | 11.38 | 1922 | 10.89 | 2698 | 11.5 | 3474 | 12.06 |
| 372 | 10.73 | 1148 | 11.38 | 1924 | 10.9 | 2700 | 11.5 | 3476 | 12.06 |
| 374 | 10.73 | 1150 | 11.38 | 1926 | 10.9 | 2702 | 11.51 | 3478 | 12.07 |
| 376 | 10.74 | 1152 | 11.38 | 1928 | 10.9 | 2704 | 11.52 | 3480 | 12.07 |
| 378 | 10.75 | 1154 | 11.38 | 1930 | 10.91 | 2706 | 11.52 | 3482 | 12.07 |
| 380 | 10.75 | 1156 | 11.38 | 1932 | 10.9 | 2708 | 11.52 | 3484 | 12.07 |
| 382 | 10.78 | 1158 | 11.37 | 1934 | 10.91 | 2710 | 11.52 | 3486 | 12.06 |
| 384 | 10.77 | 1160 | 11.37 | 1936 | 10.89 | 2712 | 11.52 | 3488 | 12.07 |

| Dist. | Elev. | Dist. | Elev. | Dist. | Elev. | Dist. | Elev. | Dist. | Elev. |
|---|---|---|---|---|---|---|---|---|---|
| 386 | 10.78 | 1162 | 11.37 | 1938 | 10.89 | 2714 | 11.52 | 3490 | 12.07 |
| 388 | 10.79 | 1164 | 11.37 | 1940 | 10.89 | 2716 | 11.52 | 3492 | 12.08 |
| 390 | 10.8 | 1166 | 11.38 | 1942 | 10.89 | 2718 | 11.52 | 3494 | 12.08 |
| 392 | 10.81 | 1168 | 11.38 | 1944 | 10.89 | 2720 | 11.52 | 3496 | 12.08 |
| 394 | 10.81 | 1170 | 11.39 | 1946 | 10.88 | 2722 | 11.52 | 3498 | 12.09 |
| 396 | 10.82 | 1172 | 11.38 | 1948 | 10.88 | 2724 | 11.51 | 3500 | 12.09 |
| 398 | 10.83 | 1174 | 11.38 | 1950 | 10.87 | 2726 | 11.51 | 3502 | 12.08 |
| 400 | 10.84 | 1176 | 11.39 | 1952 | 10.87 | 2728 | 11.51 | 3504 | 12.08 |
| 402 | 10.85 | 1178 | 11.4 | 1954 | 10.87 | 2730 | 11.5 | 3506 | 12.08 |
| 404 | 10.86 | 1180 | 11.41 | 1956 | 10.86 | 2732 | 11.5 | 3508 | 12.08 |
| 406 | 10.86 | 1182 | 11.41 | 1958 | 10.88 | 2734 | 11.5 | 3510 | 12.08 |
| 408 | 10.86 | 1184 | 11.42 | 1960 | 10.87 | 2736 | 11.5 | 3512 | 12.09 |
| 410 | 10.86 | 1186 | 11.43 | 1962 | 10.86 | 2738 | 11.51 | 3514 | 12.1 |
| 412 | 10.85 | 1188 | 11.44 | 1964 | 10.87 | 2740 | 11.51 | 3516 | 12.1 |
| 414 | 10.86 | 1190 | 11.44 | 1966 | 10.87 | 2742 | 11.51 | 3518 | 12.1 |
| 416 | 10.86 | 1192 | 11.45 | 1968 | 10.86 | 2744 | 11.52 | 3520 | 12.1 |
| 418 | 10.87 | 1194 | 11.46 | 1970 | 10.85 | 2746 | 11.52 | 3522 | 12.1 |
| 420 | 10.87 | 1196 | 11.46 | 1972 | 10.85 | 2748 | 11.52 | 3524 | 12.11 |
| 422 | 10.87 | 1198 | 11.46 | 1974 | 10.85 | 2750 | 11.52 | 3526 | 12.11 |
| 424 | 10.87 | 1200 | 11.46 | 1976 | 10.86 | 2752 | 11.53 | 3528 | 12.12 |
| 426 | 10.87 | 1202 | 11.47 | 1978 | 10.85 | 2754 | 11.53 | 3530 | 12.13 |
| 428 | 10.86 | 1204 | 11.48 | 1980 | 10.86 | 2756 | 11.53 | 3532 | 12.13 |
| 430 | 10.85 | 1206 | 11.48 | 1982 | 10.86 | 2758 | 11.52 | 3534 | 12.13 |
| 432 | 10.84 | 1208 | 11.48 | 1984 | 10.86 | 2760 | 11.52 | 3536 | 12.13 |
| 434 | 10.84 | 1210 | 11.49 | 1986 | 10.87 | 2762 | 11.52 | 3538 | 12.14 |
| 436 | 10.83 | 1212 | 11.5 | 1988 | 10.87 | 2764 | 11.52 | 3540 | 12.14 |
| 438 | 10.83 | 1214 | 11.5 | 1990 | 10.87 | 2766 | 11.52 | 3542 | 12.13 |
| 440 | 10.84 | 1216 | 11.5 | 1992 | 10.87 | 2768 | 11.52 | 3544 | 12.13 |
| 442 | 10.85 | 1218 | 11.5 | 1994 | 10.87 | 2770 | 11.53 | 3546 | 12.13 |
| 444 | 10.86 | 1220 | 11.5 | 1996 | 10.88 | 2772 | 11.53 | 3548 | 12.11 |
| 446 | 10.87 | 1222 | 11.5 | 1998 | 10.87 | 2774 | 11.53 | 3550 | 12.1 |
| 448 | 10.87 | 1224 | 11.49 | 2000 | 10.88 | 2776 | 11.54 | 3552 | 12.07 |
| 450 | 10.88 | 1226 | 11.49 | 2002 | 10.87 | 2778 | 11.53 | 3554 | 12.06 |
| 452 | 10.89 | 1228 | 11.49 | 2004 | 10.88 | 2780 | 11.53 | 3556 | 12.07 |
| 454 | 10.9 | 1230 | 11.48 | 2006 | 10.88 | 2782 | 11.54 | 3558 | 12.08 |
| 456 | 10.92 | 1232 | 11.47 | 2008 | 10.88 | 2784 | 11.54 | 3560 | 12.09 |
| 458 | 10.93 | 1234 | 11.46 | 2010 | 10.88 | 2786 | 11.54 | 3562 | 12.1 |
| 460 | 10.94 | 1236 | 11.46 | 2012 | 10.88 | 2788 | 11.54 | 3564 | 12.11 |
| 462 | 10.95 | 1238 | 11.48 | 2014 | 10.89 | 2790 | 11.53 | 3566 | 12.11 |
| 464 | 10.95 | 1240 | 11.46 | 2016 | 10.9 | 2792 | 11.53 | 3568 | 12.12 |
| 466 | 10.95 | 1242 | 11.47 | 2018 | 10.89 | 2794 | 11.53 | 3570 | 12.06 |
| 468 | io.95 | 1244 | 11.47 | 2020 | 10.89 | 2796 | 11.53 | 3572 | 12.01 |
| 470 | 10.95 | 1246 | 11.47 | 2022 | 10.89 | 2798 | 11.54 | 3574 | 12.03 |
| 472 | 10.95 | 1248 | 11.47 | 2024 | 10.89 | 2800 | 11.54 | 3576 | 12.04 |
| 474 | 10.96 | 1250 | 11.46 | 2026 | 10.9 | 2802 | 11.54 | 3578 | 12.05 |
| 476 | 10.97 | 1252 | 11.45 | 2028 | 10.89 | 2804 | 11.55 | 3580 | 12.05 |
| 478 | 10.98 | 1254 | 11.45 | 2030 | 10.89 | 2806 | 11.55 | 3582 | 12.06 |
| 480 | 10.98 | 1256 | 11.45 | 2032 | 10.88 | 2808 | 11.55 | 3584 | 12.06 |
| 482 | 10.99 | 1258 | 11.46 | 2034 | 10.87 | 2810 | 11.56 | 3586 | 12.05 |
| 484 | 10.99 | 1260 | 11.46 | 2036 | 10.88 | 2812 | 11.55 | 3588 | 12.04 |
| 486 | 10.99 | 1262 | 11.46 | 2038 | 10.87 | 2814 | 11.55 | 3590 | 12.03 |

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|---|---|---|---|---|---|---|---|---|---|
| 488 | 11 | 1264 | 11.45 | 2040 | 10.87 | 2816 | 11.55 | 3592 | 12.02 |
| 490 | 11.01 | 1266 | 11.45 | 2042 | 10.87 | 2818 | 11.55 | 3594 | 12.02 |
| 492 | 11.01 | 1268 | 11.45 | 2044 | 10.87 | 2820 | 11.54 | 3596 | 12.02 |
| 494 | 11.01 | 1270 | 11.45 | 2046 | 10.88 | 2822 | 11.53 | 3598 | 12.02 |
| 496 | 11.01 | 1272 | 11.45 | 2048 | 10.88 | 2824 | 11.53 | 3600 | 12.01 |
| 498 | 10.98 | 1274 | 11.46 | 2050 | 10.88 | 2826 | 11.53 | 3602 | 11.99 |
| 500 | 10.96 | 1276 | 11.46 | 2052 | 10.88 | 2828 | 11.51 | 3604 | 11.98 |
| 502 | 10.95 | 1278 | 11.46 | 2054 | 10.88 | 2830 | 11.52 | 3606 | 11.94 |
| 504 | 10.95 | 1280 | 11.48 | 2056 | 10.88 | 2832 | 11.52 | 3608 | 11.94 |
| 506 | 10.95 | 1282 | 11.47 | 2058 | 10.89 | 2834 | 11.53 | 3610 | 11.93 |
| 508 | 10.96 | 1284 | 11.47 | 2060 | 10.89 | 2836 | 11.53 | 3612 | 11.93 |
| 510 | 10.97 | 1286 | 11.48 | 2062 | 10.89 | 2838 | 11.54 | 3614 | 11.92 |
| 512 | 10.97 | 1288 | 11.48 | 2064 | 10.89 | 2840 | 11.55 | 3616 | 11.91 |
| 514 | 10.98 | 1290 | 11.48 | 2066 | 10.89 | 2842 | 11.56 | 3618 | 11.9 |
| 516 | 10.97 | 1292 | 11.48 | 2068 | 10.89 | 2844 | 11.56 | 3620 | 11.9 |
| 518 | 10.97 | 1294 | 11.49 | 2070 | 10.89 | 2846 | 11.57 | 3622 | 11.9 |
| 520 | 10.98 | 1296 | 11.49 | 2072 | 10.88 | 2848 | 11.57 | 3624 | 11.9 |
| 522 | 10.99 | 1298 | 11.5 | 2074 | 10.88 | 2850 | 11.57 | 3626 | 11.9 |
| 524 | 11 | 1300 | 11.51 | 2076 | 10.89 | 2852 | 11.58 | 3628 | 11.91 |
| 526 | 11.01 | 1302 | 11.52 | 2078 | 10.88 | 2854 | 11.58 | 3630 | 11.9 |
| 528 | 11.03 | 1304 | 11.52 | 2080 | 10.89 | 2856 | 11.58 | 3632 | 11.88 |
| 530 | 11.03 | 1306 | 11.52 | 2082 | 10.88 | 2858 | 11.58 | 3634 | 11.87 |
| 532 | 11.03 | 1308 | 11.52 | 2084 | 10.88 | 2860 | 11.58 | 3636 | 11.87 |
| 534 | 11.03 | 1310 | 11.52 | 2086 | 10.88 | 2862 | 11.58 | 3638 | 11.86 |
| 536 | 11.03 | 1312 | 11.52 | 2088 | 10.88 | 2864 | 11.59 | 3640 | 11.86 |
| 538 | 11.03 | 1314 | 11.52 | 2090 | 10.88 | 2866 | 11.59 | 3642 | 11.85 |
| 540 | 11.03 | 1316 | 11.53 | 2092 | 10.87 | 2868 | 11.59 | 3644 | 11.86 |
| 542 | 11.03 | 1318 | 11.52 | 2094 | 10.87 | 2870 | 11.59 | 3646 | 11.86 |
| 544 | 11.02 | 1320 | 11.52 | 2096 | 10.87 | 2872 | 11.58 | 3648 | 11.85 |
| 546 | 11.02 | 1322 | 11.52 | 2098 | 10.87 | 2874 | 11.57 | 3650 | 11.85 |
| 548 | 11.03 | 1324 | 11.53 | 2100 | 10.87 | 2876 | 11.57 | 3652 | 11.85 |
| 550 | 11.04 | 1326 | 11.53 | 2102 | 10.88 | 2878 | 11.58 | 3654 | 11.86 |
| 552 | 11.05 | 1328 | 11.53 | 2104 | 10.88 | 2880 | 11.57 | 3656 | 11.86 |
| 554 | 11.05 | 1330 | 11.53 | 2106 | 10.88 | 2882 | 11.57 | 3658 | 11.87 |
| 556 | 11.04 | 1332 | 11.53 | 2108 | 10.89 | 2884 | 11.57 | 3660 | 11.86 |
| 558 | 11.06 | 1334 | 11.53 | 2110 | 10.89 | 2886 | 11.58 | 3662 | 11.86 |
| 560 | 11.07 | 1336 | 11.54 | 2112 | 10.9 | 2888 | 11.58 | 3664 | 11.85 |
| 562 | 11.07 | 1338 | 11.53 | 2114 | 10.91 | 2890 | 11.59 | 3666 | 11.84 |
| 564 | 11.08 | 1340 | 11.52 | 2116 | 10.92 | 2892 | 11.6 | 3668 | 11.85 |
| 566 | 11.08 | 1342 | 11.52 | 2118 | 10.92 | 2894 | 11.62 | 3670 | 11.85 |
| 568 | 11.09 | 1344 | 11.51 | 2120 | 10.93 | 2896 | 11.61 | 3672 | 11.87 |
| 570 | 11.1 | 1346 | 11.53 | 2122 | 10.92 | 2898 | 11.61 | 3674 | 11.89 |
| 572 | 11.12 | 1348 | 11.52 | 2124 | 10.92 | 2900 | 11.61 | 3676 | 11.88 |
| 574 | 11.13 | 1350 | 11.54 | 2126 | 10.92 | 2902 | 11.61 | 3678 | 11.88 |
| 576 | 11.14 | 1352 | 11.53 | 2128 | 10.92 | 2904 | 11.61 | 3680 | 11.88 |
| 578 | 11.14 | 1354 | 11.54 | 2130 | 10.92 | 2906 | 11.62 | 3682 | 11.89 |
| 580 | 11.15 | 1356 | 11.53 | 2132 | 10.92 | 2908 | 11.63 | 3684 | 11.9 |
| 582 | 11.16 | 1358 | 11.54 | 2134 | 10.92 | 2910 | 11.64 | 3686 | 11.91 |
| 584 | 11.17 | 1360 | 11.53 | 2136 | 10.93 | 2912 | 11.65 | 3688 | 11.91 |
| 586 | 11.17 | 1362 | 11.54 | 2138 | 10.93 | 2914 | 11.66 | 3690 | 11.91 |
| 588 | 11.17 | 1364 | 11.55 | 2140 | 10.93 | 2916 | 11.67 | 3692 | 11.91 |
| 590 | 11.17 | 1366 | 11.54 | 2142 | 10.93 | 2918 | 11.67 | 3694 | 11.92 |

| Dist. | Elev. | Dist. | Elev. | Dist. | Elev. | Dist. | Elev. | Dist. | Elev. |
|---|---|---|---|---|---|---|---|---|---|
| 592 | 11.17 | 1368 | 11.54 | 2144 | 10.93 | 2920 | 11.67 | 3696 | 11.92 |
| 594 | 11.18 | 1370 | 11.54 | 2146 | 10.94 | 2922 | 11.68 | 3698 | 11.93 |
| 596 | 11.18 | 1372 | 11.54 | 2148 | 10.93 | 2924 | 11.7 | 3700 | 11.94 |
| 598 | 11.18 | 1374 | 11.53 | 2150 | 10.93 | 2926 | 11.72 | 3702 | 11.94 |
| 600 | 11.17 | 1376 | 11.52 | 2152 | 10.93 | 2928 | 11.73 | 3704 | 11.95 |
| 602 | 11.17 | 1378 | 11.51 | 2154 | 10.93 | 2930 | 11.74 | 3706 | 11.95 |
| 604 | 11.17 | 1380 | 11.5 | 2156 | 10.93 | 2932 | 11.76 | 3708 | 11.95 |
| 606 | 11.17 | 1382 | 11.49 | 2158 | 10.92 | 2934 | 11.77 | 3710 | 11.95 |
| 608 | 11.19 | 1384 | 11.49 | 2160 | 10.92 | 2936 | 11.78 | 3712 | 11.95 |
| 610 | 11.17 | 1386 | 11.49 | 2162 | 10.91 | 2938 | 11.8 | 3714 | 11.96 |
| 612 | 11.18 | 1388 | 11.49 | 2164 | 10.9 | 2940 | 11.82 | 3716 | 11.95 |
| 614 | 11.18 | 1390 | 11.49 | 2166 | 10.92 | 2942 | 11.82 | 3718 | 11.95 |
| 616 | 11.18 | 1392 | 11.48 | 2168 | 10.91 | 2944 | 11.82 | 3720 | 11.96 |
| 618 | 11.19 | 1394 | 11.47 | 2170 | 10.91 | 2946 | 11.83 | 3722 | 11.97 |
| 620 | 11.19 | 1396 | 11.47 | 2172 | 10.9 | 2948 | 11.82 | 3724 | 11.98 |
| 622 | 11.19 | 1398 | 11.47 | 2174 | 10.9 | 2950 | 11.82 | 3726 | 11.98 |
| 624 | 11.2 | 1400 | 11.46 | 2176 | 10.9 | 2952 | 11.83 | 3728 | 11.99 |
| 626 | 11.21 | 1402 | 11.47 | 2178 | 10.88 | 2954 | 11.84 | 3730 | 12 |
| 628 | 11.21 | 1404 | 11.47 | 2180 | 10.88 | 2956 | 11.83 | 3732 | 12 |
| 630 | 11.21 | 1406 | 11.48 | 2182 | 10.86 | 2958 | 11.83 | 3734 | 11.99 |
| 632 | 11.2 | 1408 | 11.47 | 2184 | 10.85 | 2960 | 11.83 | 3736 | 11.99 |
| 634 | 11.2 | 1410 | 11.46 | 2186 | 10.85 | 2962 | 11.83 | 3738 | 11.99 |
| 636 | 11.2 | 1412 | 11.46 | 2188 | 10.84 | 2964 | 11.83 | 3740 | 12 |
| 638 | 11.19 | 1414 | 11.46 | 2190 | 10.84 | 2966 | 11.83 | 3742 | 12 |
| 640 | 11.18 | 1416 | 11.46 | 2192 | 10.84 | 2968 | 11.84 | 3744 | 12.01 |
| 642 | 11.18 | 1418 | 11.46 | 2194 | 10.84 | 2970 | 11.85 | 3746 | 12.02 |
| 644 | 11.17 | 1420 | 11.47 | 2196 | 10.85 | 2972 | 11.86 | 3748 | 12.02 |
| 646 | 11.16 | 1422 | 11.47 | 2198 | 10.85 | 2974 | 11.87 | 3750 | 12.03 |
| 648 | 11.15 | 1424 | 11.47 | 2200 | 10.85 | 2976 | 11.88 | 3752 | 12.04 |
| 650 | 11.14 | 1426 | 11.46 | 2202 | 10.85 | 2978 | 11.88 | 3754 | 12.05 |
| 652 | 11.14 | 1428 | 11.46 | 2204 | 10.85 | 2980 | 11.89 | 3756 | 12.06 |
| 654 | 11.14 | 1430 | 11.44 | 2206 | 10.85 | 2982 | 11.9 | 3758 | 12.06 |
| 656 | 11.12 | 1432 | 11.43 | 2208 | 10.86 | 2984 | 11.9 | 3760 | 12.06 |
| 658 | 11.11 | 1434 | 11.41 | 2210 | 10.86 | 2986 | 11.9 | 3762 | 12.06 |
| 660 | 11.09 | 1436 | 11.4 | 2212 | 10.86 | 2988 | 11.9 | 3764 | 12.06 |
| 662 | 11.09 | 1438 | 11.39 | 2214 | 10.87 | 2990 | 11.9 | 3766 | 12.06 |
| 664 | 11.09 | 1440 | 11.38 | 2216 | 10.88 | 2992 | 11.9 | 3768 | 12.06 |
| 666 | 11.09 | 1442 | 11.37 | 2218 | 10.88 | 2994 | 11.91 | 3770 | 12.06 |
| 668 | 11.09 | 1444 | 11.36 | 2220 | 10.89 | 2996 | 11.91 | 3772 | 12.07 |
| 670 | 11.09 | 1446 | 11.36 | 2222 | 10.9 | 2998 | 11.9 | 3774 | 12.08 |
| 672 | 11.09 | 1448 | 11.35 | 2224 | 10.91 | 3000 | 11.91 | 3776 | 12.09 |
| 674 | 11.09 | 1450 | 11.35 | 2226 | 10.91 | 3002 | 11.91 | 3778 | 12.1 |
| 676 | 11.09 | 1452 | 11.35 | 2228 | 10.92 | 3004 | 11.91 | 3780 | 12.09 |
| 678 | 11.09 | 1454 | 11.35 | 2230 | 10.92 | 3006 | 11.91 | 3782 | 12.12 |
| 680 | 11.09 | 1456 | 11.35 | 2232 | 10.93 | 3008 | 11.9 | 3784 | 12.13 |
| 682 | 11.09 | 1458 | 11.34 | 2234 | 10.94 | 3010 | 11.91 | 3786 | 12.14 |
| 684 | 11.09 | 1460 | 11.34 | 2236 | 10.94 | 3012 | 11.91 | 3788 | 12.13 |
| 686 | 11.08 | 1462 | 11.33 | 2238 | 10.95 | 3014 | 11.92 | 3790 | 12.14 |
| 688 | 11.08 | 1464 | 11.32 | 2240 | 10.96 | 3016 | 11.92 | 3792 | 12.14 |
| 690 | 11.08 | 1466 | 11.32 | 2242 | 10.96 | 3018 | 11.92 | 3794 | 12.14 |
| 692 | 11.08 | 1468 | 11.32 | 2244 | 10.97 | 3020 | 11.92 | 3796 | 12.15 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 694 | 11.07 | 1470 | 11.31 | 2246 | 10.99 | 3022 | 11.92 | 3798 | 12.15 |
| 696 | 11.06 | 1472 | 11.31 | 2248 | 10.99 | 3024 | 11.92 | 3800 | 12.16 |
| 698 | 11.05 | 1474 | 11.3 | 2250 | 10.99 | 3026 | 11.92 | 3802 | 12.16 |
| 700 | 11.04 | 1476 | 11.29 | 2252 | 10.99 | 3028 | 11.91 | 3804 | 12.17 |
| 702 | 11.03 | 1478 | 11.29 | 2254 | 11 | 3030 | 11.91 | 3806 | 12.17 |
| 704 | 11.02 | 1480 | 11.28 | 2256 | 11 | 3032 | 11.92 | 3808 | 12.17 |
| 706 | 11.01 | 1482 | 11.28 | 2258 | 11 | 3034 | 11.91 | 3810 | 12.15 |
| 708 | 11 | 1484 | 11.28 | 2260 | 11.01 | 3036 | 11.91 | 3812 | 12.14 |
| 710 | 10.99 | 1486 | 11.28 | 2262 | 11.01 | 3038 | 11.91 | 3814 | 12.13 |
| 712 | 10.99 | 1488 | 11.28 | 2264 | 11.02 | 3040 | 11.91 | 3816 | 12.12 |
| 714 | 10.98 | 1490 | 11.27 | 2266 | 11.02 | 3042 | 11.9 | 3818 | 12.11 |
| 716 | 10.99 | 1492 | 11.27 | 2268 | 11.02 | 3044 | 11.9 | 3820 | 12.1 |
| 718 | 10.98 | 1494 | 11.27 | 2270 | 11.04 | 3046 | 11.9 | 3822 | 12.09 |
| 720 | 10.98 | 1496 | 11.26 | 2272 | 11.05 | 3048 | 11.9 | 3824 | 12.09 |
| 722 | 10.98 | 1498 | 11.26 | 2274 | 11.05 | 3050 | 11.9 | 3826 | 12.09 |
| 724 | 10.98 | 1500 | 11.25 | 2276 | 11.06 | 3052 | 11.9 | 3828 | 12.08 |
| 726 | 10.98 | 1502 | 11.25 | 2278 | 11.06 | 3054 | 11.9 | 3830 | 12.07 |
| 728 | 10.98 | 1504 | 11.24 | 2280 | 11.05 | 3056 | 11.9 | 3832 | 12.07 |
| 730 | 10.99 | 1506 | 11.23 | 2282 | 11.04 | 3058 | 11.9 | 3834 | 12.06 |
| 732 | 10.99 | 1508 | 11.22 | 2284 | 11.03 | 3060 | 11.9 | 3836 | 12.05 |
| 734 | 11 | 1510 | 11.21 | 2286 | 11.03 | 3062 | 11.91 | 3838 | 12.03 |
| 736 | 11 | 1512 | 11.19 | 2288 | 11.02 | 3064 | 11.92 | 3840 | 12.03 |
| 738 | 11 | 1514 | 11.18 | 2290 | 11.03 | 3066 | 11.92 | 3842 | 12.02 |
| 740 | 11 | 1516 | 11.17 | 2292 | 11.03 | 3068 | 11.92 | 3844 | 12.01 |
| 742 | 11 | 1518 | 11.17 | 2294 | 11.04 | 3070 | 11.93 | 3846 | 12.02 |
| 744 | 11.01 | 1520 | 11.15 | 2296 | 11.05 | 3072 | 11.93 | 3848 | 12.01 |
| 746 | 11.02 | 1522 | 11.13 | 2298 | 11.06 | 3074 | 11.93 | 3850 | 12.01 |
| 748 | 11.02 | 1524 | 11.12 | 2300 | 11.07 | 3076 | 11.93 | 3852 | 12.01 |
| 750 | 11.02 | 1526 | 11.1 | 2302 | 11.09 | 3078 | 11.94 | 3854 | 12.01 |
| 752 | 11.02 | 1528 | 11.1 | 2304 | 11.1 | 3080 | 11.94 | 3856 | 12.02 |
| 754 | 11.02 | 1530 | 11.18 | 2306 | 11.1 | 3082 | 11.95 | 3858 | 12.02 |
| 756 | 11.02 | 1532 | 11.17 | 2308 | 11.11 | 3084 | 11.95 | 3860 | 12.01 |
| 758 | 11.01 | 1534 | 11.14 | 2310 | 11.12 | 3086 | 11.95 | 3862 | 12 |
| 760 | 11.01 | 1536 | 11.14 | 2312 | 11.14 | 3088 | 11.96 | 3864 | 12 |
| 762 | 11 | 1538 | 11.12 | 2314 | 11.14 | 3090 | 11.96 | 3866 | 11.98 |
| 764 | 11 | 1540 | 11 | 2316 | 11.15 | 3092 | 11.96 | 3868 | 11.97 |
| 766 | 11 | 1542 | 10.97 | 2318 | 11.16 | 3094 | 11.96 | 3870 | 11.97 |
| 768 | 11 | 1544 | 10.95 | 2320 | 11.16 | 3096 | 11.96 | 3872 | 11.96 |
| 770 | 11 | 1546 | 10.94 | 2322 | 11.16 | 3098 | 11.96 | 3874 | 11.96 |
| 772 | 11 | 1548 | 10.92 | 2324 | 11.15 | 3100 | 11.95 | 3876 | 11.96 |
| 774 | 10.99 | 1550 | 10.91 | 2326 | 11.15 | 3102 | 11.94 | 3878 | 11.96 |
| | | | | | | | | 3880 | 11.95 |

'The National Aeronautics and Space Administration (NASA) Report CR- 119 identifies an elevation of 10.97 inches at 1620 feet. This is considered a typographical error and has been corrected in Table 1. The elevation is 10.87 inches.

**TABLE 2**

**SF28R SEVERE BUMP MODIFICATIONS**
**PER ICAO ANNEX 14, SPECIFICATION 9.4.15**

| Distance | Original Elevation (ft) | Modified Elevation (ft) |
|---|---|---|
| 1530 | 11.18 | 11.10 |
| 1532 | 11.17 | 11.11 |
| 1534 | 11.14 | 11.11 |
| 1536 | 11.14 | 11.07 |
| 1538 | 11.12 | 11.04 |

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**FORWARDING AND ADDRESS
CORRECTION REQUESTED**

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